AP

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of
ZHANG et al.
Serial No. 10/813,131
Filed: March 31, 2004

Atty. Ref.: 839-1546
TC/A.U.: 3745
Examiner: C. M. Verdier

For: COUNTER-BORED FILM-COOLING HOLES AND RELATED METHOD

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November 13, 2006

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

Applicant hereby appeals to the Board of Patent Appeals and Interferences from the Final Rejection dated April 14, 2006.

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(I) REAL PARTY IN INTEREST

The real party in interest is General Electric Company, a corporation of New York, having a business address at 1 River Road, Schenectady, New York 12345.

(II) RELATED APPEALS AND INTERFERENCES

The appellant, the undersigned, and the assignee are not aware of any related appeals, interferences, or judicial proceedings (past or present), which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(III) STATUS OF CLAIMS

Claims 1-13 are pending and have been rejected. No claims have been allowed.

(IV) STATUS OF AMENDMENTS

An Amendment dated August 10, 2006, filed after the Final Rejection, was entered by the Examiner as confirmed in an Advisory Action dated August 24, 2006. The claims as presented in the "Claims Appendix" include the changes made in the August 10, 2006 Amendment.

(V) SUMMARY OF CLAIMED SUBJECT MATTER

Film-cooling has been a major aspect of gas turbine cooling for many years. The application of effective film-cooling techniques provides the first and best line of defense for hot gas path surfaces against the onslaught of extreme heat fluxes, serving to directly reduce the incident convective heat flux on the surface. The present invention solves a problem relating to the partial obstruction of film cooling holes (see Fig. 2) due to a

thermal barrier coating sprayed on, for example, the air foil portions of turbine buckets, by changing the configuration of the film cooling holes to include a counterbore at the outlet or exit ends of the film cooling holes, thereby providing space for excess coating material.

Independent claim 1 calls for a turbine component 10 or 34 provided with a plurality of film cooling holes 28 (page 4, paragraphs 13, 14 and Fig. 1) each formed in a region of the component to be cooled, the cooling holes each having a specified uniform diameter, and each hole at an exit end formed with a concentric counterbore 40 of predetermined depth. Each hole and its respective counterbore are parallel and connected by a 90° shoulder, with the component 10 or 34 having a coating 30 applied thereto at least in the region to be cooled, wherein the counterbore provides an area for excess coating material to accumulate without reducing the specified diameter of the film cooling hole. (Page 5, paragraph 16 and Fig. 3.)

Independent claim 10 is more specific in terms of defining the component as a gas turbine bucket 34 having an airfoil portion 12 and a shank portion 15.

The dependent claims contain further details regarding dimensional relationships between the film cooling holes, the counterbores, coating material and coating composition (page 5, paragraph 16 and Fig. 3).

(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(a) The rejection of claims 1, 2, 4-6, 7 and 9-13 under 35 U.S.C. § 103 as being unpatentable over Gupta (US 5,771,577) in view of Kercher (US 3,542,486).

(b) The rejection of claims 3 and 8 under 35 U.S.C. § 103 as unpatentable over Gupta ('577) and Kercher ('486) and further in view of Fric (US 6,383,602).

(VII) ARGUMENT

(a) Claims 1, 2, 4-7 and 9-13 have been improperly rejected as unpatentable over Gupta ('577) in view of Kercher ('486).

At the outset, appellant regards claims 2, 4-7, 9, 11 and 12 as standing or falling with their respective independent claims.

The USPTO has the burden under 35 U.S.C. §103 of establishing a prima facie case of obviousness. In re Piasecki, 745 F.2d 1468, 1471-72 223 U.S.P.Q 785, 787-88 (Fed. Cir. 1984). It can satisfy this burden only by showing that some objective teaching in the prior art, or that knowledge generally available to one of ordinary skill in the art, would have led that individual to combine the relevant teachings of the references to arrive at the claimed invention. In re Fine, 837 F.2d. 1071, 1074, 5 U.S.P.Q. 2d 1596, 1598 (Fed. Cir. 1988). Before the U.S.P.T.O. may combine the disclosures of the references in order to establish a prima facie case of obviousness, however, there must be some suggestion for doing so. In other words, in any obviousness analysis under 35 U.S.C. § 103, it must be shown that there was a motivation or suggestion in the prior art to make the combination or modification. In re Rouffet, 149 F.3d. 1350, 1357-58 (Fed. Cir. 1998). See also In re Kotzab, 217 F.3d. 1365, 1369 (Fed. Cir. 2000) ("Close adherence to this methodology is especially important in cases where the very ease with which the invention can be understood may prompt one 'fall victim to the insidious effect

of a hindsight syndrome wherein that which only the invention taught is used against its teacher'").

Gupta discloses a method for making a fluid cooled article with a protective coating. Gupta discloses various configuration for film cooling holes that may have special accommodation for excess coating material so as not to restrict fluid flow through the film cooling hole. In each case, the diameter of the film cooling hole 12 increases from the inlet opening 14 to the outlet 18.

More specifically, Gupta discloses various hole configurations and shapes wherein a second or outlet opening has a cross-sectional area greater than the inlet opening by an amount which is not less than the reduction in cross-sectional area resulting from a partial deposit of coating material within the second opening. After discussing the tapered passages shown in Figures 1 and 2, Gupta notes that passage opening shapes other than the tapered configurations of Figures 1 and 2 may be utilized, so long as the relative opening sizes noted above are maintained. In Figures 3A-3D and Figure 4, Gupta discloses other suitable passage shapes. In no case, however, is there disclosed or suggested a film cooling hole with a concentric counter bore at an exit end where the hole and counterbore are parallel and connected by a 90° shoulder as required by each of the independent claims 1, 10 and 13 of this application. In fact, while Gupta does indeed vary the inlet end of the passage end from a tapered configuration to a parallel wall configuration, <u>in every case the outlet end is tapered or concavely-curved in an outward direction to increase the outlet opening cross-sectional area</u>.

It is respectfully submitted that one of ordinary skill in the art would have understood from Gupta's disclosure that an outwardly tapered or concavely curved outlet opening is of significance, and that the disclosure does not embrace or suggest a concentric and parallel counterbore connected to the main passage by a 90° shoulder.

With respect to the secondary reference to Kercher, coolant holes or passage 50, 52 and 54 are provided through a blade side wall 55 adjacent the blade leading edge 56 to communicate the leading edge plenum chamber 42 with the blade exterior surface to thereby provide a film of cooling fluid that attaches itself to the exterior surface of the blade. Kercher is wholly silent with respect to any problem relating to the accumulation of excess coating material within the cooling hole. In fact, coatings are not even mentioned in Kercher. Kercher's only concern is to diffuse the cooling flow at the exit end in order to minimize mixing with external hot gas.

It is therefore respectfully submitted that the combination of Gupta and Kercher is only feasible with the utilization of impermissible hindsight gained from applicants' own disclosure. This is especially true since Gupta has made a point to disclose and describe various shapes and configurations for the exit or outlet ends of the cooling holes but without so much as a mention of the very simple but very effective configuration claimed here. This, despite the fact that the secondary reference to Kercher does disclose a similar hole configuration, but in a context other than surfaces coated with thermal barrier coatings. In other words, while the claimed hole configuration was known in other contexts, the fact that Gupta omitted this configuration from the several disclosed

acceptable configurations in the context of the collection of excess thermal barrier coating material would likely be considered a teaching away from the present invention.

It is therefore apparent that any proposed modification of Gupta that would produce the claimed invention is necessarily based on the use of impermissible hindsight gained from applicants' own disclosure, and not based on any suggestion or motivation provided by the prior art as cited and applied by the Examiner.

(b) Claims 3 and 8 have been improperly rejected under 35 U.S.C. § 103 as unpatentable over Gupta '577 and Kercher '486 and further in view of Fric '602

The tertiary reference to Fric is cited for disclosing a counterbore depth of about 0.03 in. In Fric, however, the main passage of the cooling hole and the outlet end thereof are not parallel, the resultant offset or misalignment is apparently intended to provide the desired type of disruption for the coolant flow (see column 5, lines 60-67). In any event, it is readily apparent that Fric fails to remedy the deficiencies in the base combination of Gupta and Kercher as described above and therefore, the combination of the three cited references is insufficient to establish prima facie obviousness with respect to claims 3 and 8, which contain all of the limitations of independent claims 1 and 7, respectively.

CONCLUSION

In conclusion, it is respectfully submitted that the Examiner has not made out a prima facie case of obviousness with respect to any of claims 1-13, and the rejections should therefore be reversed.

Respectfully submitted,

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(VIII) CLAIMS APPENDIX

1. A turbine component having a plurality of film-cooling holes each formed in a region of the component to be cooled, said cooling holes each having a specified uniform diameter, each hole at an exit thereof formed with a concentric counter-bore of a predetermined depth, each said hole and respective counterbore being parallel and connected by a 90° shoulder; said component having a coating applied thereto at least in said region, wherein the counter-bore provides an area for excess coating material to accumulate without reducing the specified diameter.

2. The turbine component of claim 1 wherein, for a specified diameter of about 0.033 inch, the counter-bore has a diameter of about 0.053 inch.

3. The turbine component of claim 2 wherein the counter-bore has a depth of about 0.030 inch.

4. The turbine component of claim 2 wherein said coating comprises a first bondcoat layer and a second thermal barrier coating layer.

5. The turbine component of claim 4 wherein the bondcoat layer is an NiAl-based material.

6. The turbine component of claim 5 wherein the thermal barrier coating layer is a yttria stabilized zirconium material.

7. The turbine component of claim 1 wherein the turbine component comprises a gas turbine bucket having an airfoil portion and a shank portion, and wherein said region comprises the airfoil portion.

8. The turbine component of claim 7 wherein, for a specified diameter of about 0.033 inch, the counter-bore has a diameter of about 0.053 inch; and wherein the counter-bore has a depth of about 0.030 inch.

9. The turbine component of claim 7 wherein said coating comprises a first bondcoat layer and a second thermal barrier coating layer; and wherein the bondcoat layer is an NiAl-based material.

10. A gas turbine bucket having an airfoil portion and a shank portion, said airfoil portion having a plurality of film-cooling holes therein, each hole having a specified diameter and at an exit thereof is formed with a concentric counter-bore of predetermined depth, each said hole and respective counterbore being parallel and connected by a 90° shoulder; said component having a coating applied thereto at least in said region, wherein the counter-bore provides an area for excess coating material to accumulate without reducing the specified diameter; and wherein said coating comprises a first bondcoat layer and a second thermal barrier coating layer.

11. The gas turbine bucket of claim 10 wherein the bondcoat layer is an NiAl-based material.

12. The gas turbine bucket of claim 11 wherein the thermal barrier coating layer is a yttria-stabilized zirconium layer.

13. A method of maintaining cooling efficiency of film-cooling holes in a turbine component where the film-cooling holes have specified diameters and the turbine component has a protective coating thereon comprising:

a) before coating, forming each film-cooling hole with a concentric counter-bore at an exit end of the film-cooling hole, each said hole and respective counterbore being parallel and connected by a 90° shoulder; and

b) spraying the coating onto the turbine component at least in areas surrounding the film-cooling holes such that excess coating material accumulates in the counter-bore without reducing the specified diameters of the cooling holes.

(IX) EVIDENCE APPENDIX

(X) RELATED PROCEEDINGS APPENDIX